PATENT ABSTRACTS OF JAPAN

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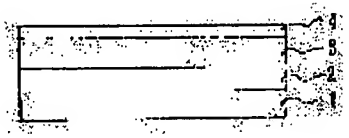
(54) INTENSIFYING SCREEN FOR DRY PROCESS X-RAY FILM

(57)Abstract:
PURPOSE: To make it possible to rapidly obtain a transmissive film with high accuracy even to an object which is to be inspected and has a high transmission thickness by providing the surface of a base with a scattering preventive layer consisting of lead foil and a phosphor layer formed by dispersing rare earth phosphors into a binder thereon.
CONSTITUTION: The surface of the base 1 is provided with the scattering preventive layer 2 consisting of the lead foil and the phosphor layer 3 formed by dispersing the rare earth phosphors into the binder thereon. The scattering preventive layer 2 is a layer for preventing the forward and backward scattering of the X-rays at the time of using sensitizing paper and the lead foil is directly adhered on the base 1 in order to form the scattering preventive layer 2. The phosphor layer 3 is a layer for enhancing the sensitivity of an X-ray film. The phosphor layer 3 is formed simply by applying a dispersion prepd. by dispersing the rare earth phosphors into an org. solvent soln. of the binder on the scattering preventive layer 2 formed on the base 1 and drying the coating. The sensitizing paper is composed of such double laminated structure and the phosphor layer 3 is further preferably provided thereon with a transparent protective layer 4 in order to protect the phosphor layer 3 on the surface against chemical change



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TECHNICAL FIELD

[Industrial Application] This invention relates to the intensifying screen used as an object for the sensitization of a dry type X-ray film in an X-ray radiographic examination.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In the X-ray radiographic examination aiming at various industrial use roentgenography, such as a medical diagnosis and nondestructive inspection of the matter, a photograph is taken by sticking the intensifying screen to one side or both sides of an X-ray film.
[0003] It is divided roughly into the thing (henceforth a fluorometallic screen) of a laminating structured type which prepared the X-ray scattering prevention layer and non-rare earth system fluorescent substance layers, such as calcium wolframate, which consist of metallic foils, such as lead foil, one by one as the intensifying screen currently generally used conventionally the thing (henceforth rare earth fluorescent sensitized paper) of a monolayer structured type which prepared the rare earth system fluorescent substance layer on the base material, and on the base material. In addition, the former rare earth fluorescent sensitized paper is used only for the medical diagnosis as an object for wet X-ray films which uses a liquid development agent for the development of an X-ray film.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although a transparency photograph can be acquired with small X dosage since said rare earth fluorescent sensitized paper is high sensitivity, the radioparency photograph of high degree of accuracy cannot be acquired. On the other hand, although said fluorometallic screen can acquire the transparency photograph of high degree of accuracy, since sensibility is low, in order to acquire the transparency photograph of the large inspected object of transparency thickness, the irradiation time which photography takes becomes long and it lacks in quick nature.

[0005] Thus, conventionally, it was high sensitivity, and there is no intensifying screen for dry type X-ray films of high degree of accuracy, and either quick nature or precision had to be sacrificed for it to the large inspected object of transparency thickness. In addition, unlike the wet X-ray film developed by the complicated wet-developing method which consists of a development-halt-fixation-rinsing-washing process, a dry type X-ray film has the features that negatives can be developed by the simple heat developing method of only especially a heating process (it heats for 6 seconds at 133 degrees C), and is developed as an X-ray film which can conform to various nondestructive inspection.

[0006] This invention makes it a technical problem to offer the intensifying screen whenever [for the dry type X-ray films with which the transparency photograph of high degree of accuracy is promptly acquired also to the large inspected object of transparency thickness / high sensitization].

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration of an example of this invention intensifying screen.
[Drawing 2] Drawing which compared as sensibility this invention examined in the example 1, and the need irradiation time of the conventional intensifying screen.
[Drawing 3] Drawing which measured as a precision whenever [by the penetrameter of this invention examined in the example 1, and the conventional intensifying screen / discernment].
[Description of Notations]
1 ..... Base material
2 ..... Dispersion prevention layer
3 ..... Fluorescent substance layer
4 ..... Protective layer
A, B, C ..... The conventional intensifying screen
D ..... The intensifying screen of this invention

[Translation done.]

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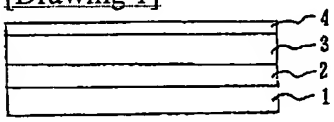
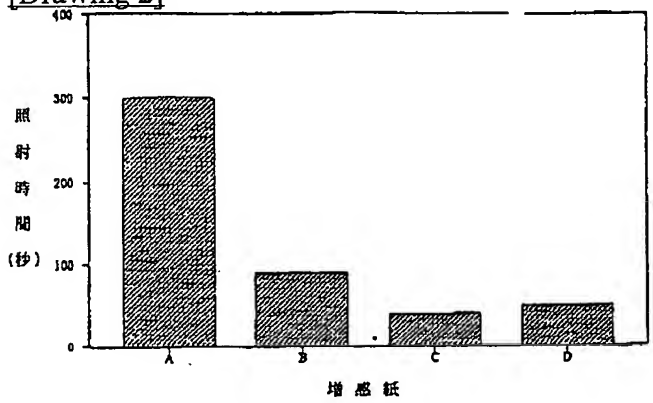
DRAWINGS

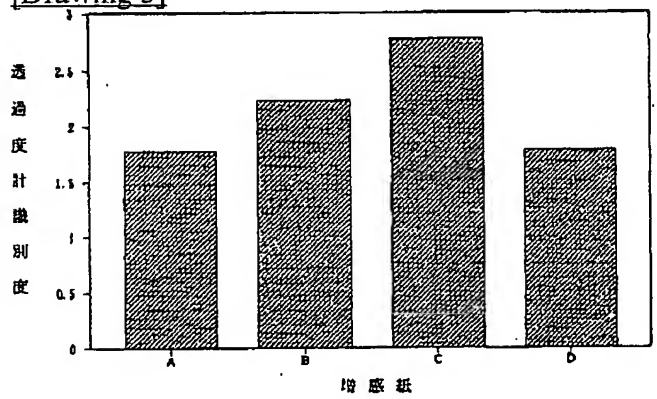
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

OPERATION

[Means for Solving the Problem and its Function] The following means were used for this invention in order to solve said technical problem. That is, the intensifying screen of this invention is what prepared the dispersion prevention layer which consists of lead foil on a base material, and the fluorescent substance layer which distributed the phosphor using rare earth elements in the binder on it, and combination use of equipment is carried out to a dry type X-ray film.
[0008] Hereafter, the intensifying screen of this invention is explained in detail with reference to drawing 1 . In addition, drawing 1 is the block diagram of the intensifying screen of an example of this invention, and, for 1, as for a dispersion prevention layer and 3, a base material and 2 are [a fluorescent substance layer and 4] transparent protection layer.
The <dispersion prevention layer 2> dispersion prevention layer 2 is a layer for preventing the front and the backscattering of an X-ray at the time of the activity of the intensifying screen, and consists of lead foil. Especially the thickness of this layer has desirable about 20-50 micrometers about 10-500 micrometers. For forming a dispersion prevention layer, lead foil is directly pasted up on a base material.
The <fluorescent substance layer 3> fluorescent substance layer 3 is a layer for raising the sensibility of an X-ray film, and distributes a phosphor using rare earth elements in a binder. Especially the thickness of this layer has desirable about 100-150 micrometers about 70-200 micrometers. By choosing the class of phosphor using rare earth elements etc. suitably as follows, this fluorescent substance layer shows remarkable sensitization, even if an X-ray film is which an orthochromatic type (type which has sensibility green), or regular type (type which has sensibility blue) type.
[0009] What is necessary is to apply the dispersion liquid which distributed the phosphor using rare earth elements, and just to dry in the organic solvent solution of a binder, on said dispersion prevention layer 2 prepared on the base material, in order to form such a fluorescent substance layer 3. In addition, a dispersant can be added in order to add a plasticizer in order to improve the bonding strength of a fluorescent substance and a binder to these dispersion liquid, or to improve the dispersibility of a fluorescent substance.
[0010] As a phosphor using rare earth elements used for a fluorescent substance layer For example, general formula IM(w-n) OwX:M1n indicated by JP,48-81582,A (However, M expresses at least one sort chosen from the group which consists of an yttrium (Y), a lanthanum (La), a gadolinium (Gd), and a lutetium (Lu).) M1 A dysprosium (Dy), an erbium (Er), europium (Eu), A holmium (Ho), neodymium (Nd), pro SEOJIMU (Pr), samarium (Sm), at least one sort chosen from the group which consists of a terbium (Tb), a thulium (Tm), and an ytterbium (Yb) is expressed, X expresses sulfur or a halogen, n is 0.0002-0.2, and w is 1 when X is a halogen, and when X is sulfur, it is 2. The fluorescent substance shown, general formula IILn2O2 S:Tb preferably indicated by JP,4-75479,B (However, one sort of Ln(s) express at least one sort of Y, La, and Gd preferably, even if there are little Y, La, Gd, and Lu.) The terbium activation rare earth oxy-sulfide shown, for example, terbium activation gadolinium oxy-sulfide, (Gd2O2 S:Tb) Terbium activation yttrium oxy-sulfide (Y2O2 S:Tb), terbium activation lanthanum oxy-sulfide (La2O2 S:Tb), terbium activation gadolinium yttrium oxy-sulfide [(Gd, Y) 2O2 S:Tb], etc. are mentioned. In addition, in the fluorescent substance of the above-mentioned general formula II, Ce, Tm, Er, Pr, etc. may be added as a coactivator of Tb.
[0011] In the fluorescent substance shown with the above-mentioned empirical formula, when the rare earth which is a parent constituent is an yttrium, luminescence is shown mainly in a blue field,

but when rare earth is a lanthanum, a gadolinium, or a lutetium, luminescence is shown mainly in a green field. Moreover, the luminescent color changes also with amounts of activation of the terbium which is an activator, and there is an inclination for luminescence of a green field to be emphasized, so that there are many amounts of a terbium. When it follows, for example, the fluorescent substance of said empirical formula is used, the luminescent color of the intensifying screen can be changed from blue in the green range by changing the amount of the terbium which is the class of rare earth which is a parent constituent and a presentation ratio, or an activator etc.

[0012] On the other hand as a binder which forms a fluorescent substance layer with the above-mentioned fluorescent substance The poly saccharides, such as protein, such as gelatin, and a dextran, gum arabic, A polyvinyl butyral, polyvinyl acetate, a nitrocellulose, ethyl cellulose, a vinylidene-chloride - vinyl chloride copolymer, polymethylmethacrylate, a vinyl chloride - vinyl acetate copolymer, polyurethane, cellulose acetate butylate, polyvinyl alcohol, and a line, although nature, such as polyester and those mixture, or the synthetic macromolecule matter is mentioned Since it excels in bending strength or flexibility as a film especially, a nitrocellulose, polyvinyl-butyral, vinyl chloride - vinyl acetate copolymer is desirable.

[0013] although the mixing ratio of the fluorescent substance in a fluorescent substance layer and a binder changes with the property of the intensifying screen made into the object, the classes of fluorescent substance, etc. -- general -- :(1-100) 1 (weight ratio) -- it is the range of :(8-40) 1 preferably.

<Base material 1> as a base material 1 for supporting the above dispersion prevention layers 2 and the fluorescent substance layer 3 For example, a polyethylene terephthalate film, a cellulose cellulose acetate film, A polyamide film, a polyimide film, a triacetate film, Plastic films, such as a polycarbonate film; Aluminium foil, Metallic foils, such as an aluminium alloy foil; although papers, such as sizing paper which sized the pigment paper containing pigments, such as a regular paper, a baryta paper, resin coat paper, and a titanium dioxide, polyvinyl alcohol, etc., and those complex are mentioned Since it excels in bending strength or flexibility especially, a plastic film, especially polyethylene terephthalate are desirable. In addition, a plastic film may be made to contain light reflex nature matter, such as optical absorption nature matter, such as carbon black, or a titanium dioxide.

[0014] Although the thickness of a base material changes with the classes variously, in the case of a plastic film, its range of about 150-200 micrometers is especially desirable about 100-300 micrometers.

Although the intensifying screen of <transparent-protection-layer 4> this invention consists of above double laminated structures, in order to protect a surface fluorescent substance layer from chemical deterioration or a physical impact, it is desirable to prepare transparent protection layer further on a fluorescent substance layer. As an ingredient which forms a protective layer, a cellulosic (for example, cellulose acetate, nitrocellulose), polymethylmethacrylate, polyvinyl-butyral, polyvinyl-formal, polycarbonate, polyvinyl acetate, vinyl chloride - vinyl acetate copolymer, polyethylene terephthalate, polyethylene, a polyvinylidene chloride, a polyamide, etc. are mentioned, for example. After it dissolves in a suitable organic solvent and these consider as a solution, apply this on a fluorescent substance layer or make it the shape of a film beforehand, they can form a protective layer for this by the fluorescent substance layer and lamination ****** with suitable adhesives. In addition, about 3-15 micrometers is suitable for protection layer thickness.

Although this is used for an inspected object, sticking the intensifying screen of <operation of this invention intensifying screen> this invention to one side or both sides of an X-ray film as usual, and guessing, in order to acquire the effectiveness of a request of this invention, an X-ray film must be the thing of the type which carries out heat developing by dry type.

[0015] Moreover, since it applies to an inspected object especially with small curvature in industrial use nondestructive inspection in many cases, in such a case, it is desirable to use the flexible good intensifying screen which is easy to bend. That whose thickness of a fluorescent substance layer it is at least one sort chosen from the group which a base material becomes from a polyethylene terephthalate film with a thickness of 100-300 micrometers, and the binder of a fluorescent substance layer becomes from a nitrocellulose, polyvinyl-butyral and vinyl chloride - vinyl acetate copolymer as the intensifying screen with good flexibility, and is 70-200 micrometers is desirable.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the intensifying screen used as an object for the sensitization of a dry type X-ray film in an X-ray radiographic examination.
[0002]
[Description of the Prior Art] In the X-ray radiographic examination aiming at various industrial use roentgenography, such as a medical diagnosis and nondestructive inspection of the matter, a photograph is taken by sticking the intensifying screen to one side or both sides of an X-ray film.
[0003] It is divided roughly into the thing (henceforth a fluorometallic screen) of a laminating structured type which prepared the X-ray scattering prevention layer and non-rare earth system fluorescent substance layers, such as calcium wolframate, which consist of metallic foils, such as lead foil, one by one as the intensifying screen currently generally used conventionally the thing (henceforth rare earth fluorescent sensitized paper) of a monolayer structured type which prepared the rare earth system fluorescent substance layer on the base material, and on the base material. In addition, the former rare earth fluorescent sensitized paper is used only for the medical diagnosis as an object for wet X-ray films which uses a liquid development agent for the development of an X-ray film.
[0004]
[Problem(s) to be Solved by the Invention] Although a transparency photograph can be acquired with small X dosage since said rare earth fluorescent sensitized paper is high sensitivity, the radioparency photograph of high degree of accuracy cannot be acquired. On the other hand, although said fluorometallic screen can acquire the transparency photograph of high degree of accuracy, since sensibility is low, in order to acquire the transparency photograph of the large inspected object of transparency thickness, the irradiation time which photography takes becomes long and it lacks in quick nature.
[0005] Thus, conventionally, it was high sensitivity, and there is no intensifying screen for dry type X-ray films of high degree of accuracy, and either quick nature or precision had to be sacrificed for it to the large inspected object of transparency thickness. In addition, unlike the wet X-ray film developed by the complicated wet-developing method which consists of a development-halt-fixation-rinsing-washing process, a dry type X-ray film has the features that negatives can be developed by the simple heat developing method of only especially a heating process (it heats for 6 seconds at 133 degrees C), and is developed as an X-ray film which can conform to various nondestructive inspection.
[0006] This invention makes it a technical problem to offer the intensifying screen whenever [for the dry type X-ray films with which the transparency photograph of high degree of accuracy is promptly acquired also to the large inspected object of transparency thickness / high sensitization].
[0007]
[Means for Solving the Problem and its Function] The following means were used for this invention in order to solve said technical problem. That is, the intensifying screen of this invention is what prepared the dispersion prevention layer which consists of lead foil on a base material, and the fluorescent substance layer which distributed the phosphor using rare earth elements in the binder on it, and combination use of equipment is carried out to a dry type X-ray film.

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[0012] On the other hand as a binder which forms a fluorescent substance layer with the above-mentioned fluorescent substance The poly saccharides, such as protein, such as gelatin, and a dextran, gum arabic, A polyvinyl butyral, polyvinyl acetate, a nitrocellulose, ethyl cellulose, a vinylidene-chloride - vinyl chloride copolymer, polymethylmethacrylate, a vinyl chloride - vinyl acetate copolymer, polyurethane, cellulose acetate butylate, polyvinyl alcohol, and a line, although nature, such as polyester and those mixture, or the synthetic macromolecule matter is mentioned Since it excels in bending strength or flexibility as a film especially, a nitrocellulose, polyvinyl-butyral, vinyl chloride - vinyl acetate copolymer is desirable.
[0013] although the mixing ratio of the fluorescent substance in a fluorescent substance layer and a binder changes with the property of the intensifying screen made into the object, the classes of

fluorescent substance, etc. -- general -- :(1-100) 1 (weight ratio) -- it is the range of :(8-40) 1 preferably.
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[0014] Although the thickness of a base material changes with the classes variously, in the case of a plastic film, its range of about 150-200 micrometers is especially desirable about 100-300 micrometers.
Although the intensifying screen of <transparent-protection-layer 4> this invention consists of above double laminated structures, in order to protect a surface fluorescent substance layer from chemical deterioration or a physical impact, it is desirable to prepare transparent protection layer further on a fluorescent substance layer. As an ingredient which forms a protective layer, a cellulosic (for example, cellulose acetate, nitrocellulose), polymethylmethacrylate, polyvinyl-butyral, polyvinyl-formal, polycarbonate, polyvinyl acetate, vinyl chloride - vinyl acetate copolymer, polyethylene terephthalate, polyethylene, a polyvinylidene chloride, a polyamide, etc. are mentioned, for example. After it dissolves in a suitable organic solvent and these consider as a solution, apply this on a fluorescent substance layer or make it the shape of a film beforehand, they can form a protective layer for this by the fluorescent substance layer and lamination ****** with suitable adhesives. In addition, about 3-15 micrometers is suitable for protection layer thickness.
Although this is used for an inspected object, sticking the intensifying screen of <operation of this invention intensifying screen> this invention to one side or both sides of an X-ray film as usual, and guessing, in order to acquire the effectiveness of a request of this invention, an X-ray film must be the thing of the type which carries out heat developing by dry type.
[0015] Moreover, since it applies to an inspected object especially with small curvature in industrial use nondestructive inspection in many cases, in such a case, it is desirable to use the flexible good intensifying screen which is easy to bend. That whose thickness of a fluorescent substance layer it is at least one sort chosen from the group which a base material becomes from a polyethylene terephthalate film with a thickness of 100-300 micrometers, and the binder of a fluorescent substance layer becomes from a nitrocellulose, polyvinyl-butyral and vinyl chloride - vinyl acetate copolymer as the intensifying screen with good flexibility, and is 70-200 micrometers is desirable.
[0016]
[Example] An example explains this invention in more detail below.
[0017]
[Example 1] The dispersion prevention layer 2 which consists of lead foil (polyester system adhesives are applied beforehand) of 30-micrometer thickness on the polyethylene terephthalate base material 1 of 188-micrometer thickness is pasted up. Dispersion liquid which formed and distributed the terbium activation gadolinium oxy-sulfide 95 weight section on it at the polyvinyl-butyral 5 weight section (a solvent) The mixed solvent of ethyl alcohol and toluene is applied to homogeneity with a doctor blade. It dried, the fluorescent substance layer 3 of 120-micrometer thickness was formed, lamination ******** 4 was further formed for the adhesive coated surface of the polyethylene terephthalate film of 9-micrometer thickness with which polyester system adhesives were beforehand applied to this fluorescent substance layer, and the intensifying screen (it expresses with the intensifying screen D hereafter) of this invention was produced.
[0018] The conventional fluorometallic screen as the intensifying screen for a comparison on the other hand (the trade name SMP 308 by Kasei Optonix, Ltd.) (with the dispersion prevention layer which consists of lead foil of 30-micrometer thickness on the paper base material of 290-micrometer thickness) it is what prepared the fluorescent substance layer of 120-micrometer thickness which

consists of tungstic-acid calcium, and the polyethylene terephthalate layer of 9-micrometer thickness one by one, and expresses with the intensifying screen A hereafter. Rare earth fluorescent sensitized paper (Du Pont trade name T6) (it is what prepared the terbium activation gadolinium oxy-sulfide Gd2O2 S:Tb fluorescent substance layer and the protective layer one by one on the paper base material, and expresses with the intensifying screen B hereafter.) [Total thickness thickness of 600 micrometers;] And rare earth fluorescent sensitized paper (Du Pont trade name T12) (total thickness thickness of 720 micrometers; it is what prepared the terbium activation gadolinium oxy-sulfide Gd2O2 S:Tb fluorescent substance layer and the protective layer one by one on the paper base material, and expresses with the intensifying screen C hereafter.) was prepared.
X-ray radiographic examination: Each above intensifying screen was stuck to the dry type X-ray film (Du Pont make) called a rapid film, the X-ray radiographic examination was performed on the following photography conditions, and the sensibility of the intensifying screen and the resolution of a transmission image were evaluated.
[0019]
The tube voltage of an X-ray, current: 160KVp, 3mA inspected object (griddle) thickness: 9mmFFD: 600mm film density: It asked for the sensibility when performing a radiographic examination under the 1.7 - 1.9 <comparison of sensibility> above-mentioned photography conditions as X-ray irradiation time required for transparency. The result is shown in drawing 2 .
[0020] It can be said that it is highly sensitive, so that the irradiation time of an X-ray is short. From drawing 2 , although it was the intensifying screen C that whose sensibility was the highest, to the intensifying screen D of this invention having sensibility almost equivalent to this intensifying screen C with the highest sensibility, the intensifying screen B had a little low sensibility, and found that sensibility was very low for the intensifying screen A.
The resolution of each transmission image obtained by performing the <comparison of resolution> above-mentioned radiographic examination was evaluated as whenever [by the penetrameter / discernment]. The result is shown in drawing 3 .
[0021] Whenever [discernment] (resolution) is so high that a numeric value is small, and it is shown that a minute defect is detectable. From drawing 3 , with the intensifying screen A, as for the intensifying screen D of this invention, whenever [discernment] is the highest, and the intensifying screen B understands at this that whenever [discernment] is the lowest for next the intensifying screen C. In addition, JIS In Z3104, whenever [discernment / which is needed by the transmission image] is 2.0.
Bending test: It evaluated winding and a bending easy for each above-mentioned intensifying screen to the pipe of 50-300mmphi. Consequently, with the intensifying screen C, the wrinkling was not accepted with other intensifying screens to the wrinkling having occurred below in 60mmphi at the curvature of the above-mentioned range. Moreover, extent which is based on the self-weight of each intensifying screen, and becomes was measured. The result was shown in a table 1.
[0022]
[A table 1]

増感紙	しなりの程度(mm)
A (従来品)	50
B (従来品)	25
C (従来品)	10
D (本発明)	55

In next the intensifying screens B and C, it is quite hard to bend the intensifying screen A to this by being the easiest to bend the intensifying screen D of this invention, and a table 1 shows that an

activity is difficult in what has small curvature.

[0023]

[Effect of the Invention] According to the intensifying screen of the metal and rare earth fluorescence body whorl structure of above this inventions, when it applies to a dry type X-ray film, precision (whenever [discernment]) and bendability can improve substantially whenever [sensitization] (quick nature) compared with the conventional intensifying screen. That is, about whenever [discernment], it became better than conventional rare earth fluorescent sensitized paper, went up [whenever / sensitization] more nearly substantially than the conventional fluorometallic screen, and became equivalent to rare earth fluorescent sensitized paper. Moreover, when the plastics and the resin bond agent which make thin especially a base material and a fluorescent substance layer, and have flexibility strong against bending in the ingredient of a base material and a fluorescent substance layer are used, it is easy to bend even if compared with which the conventional intensifying screen. Therefore, it is suitable when the intensifying screen which is easy to bend in this way is used, and examining an inspected object with small curvature especially.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the intensifying screen of the metal and rare earth fluorescence body whorl structure of above this inventions, when it applies to a dry type X-ray film, precision (whenever [discernment]) and bendability can improve substantially whenever [sensitization] (quick nature) compared with the conventional intensifying screen. That is, about whenever [discernment], it became better than conventional rare earth fluorescent sensitized paper, went up [whenever / sensitization] more nearly substantially than the conventional fluorometallic screen, and became equivalent to rare earth fluorescent sensitized paper. Moreover, when the plastics and the resin bond agent which make thin especially a base material and a fluorescent substance layer, and have flexibility strong against bending in the ingredient of a base material and a fluorescent substance layer are used, it is easy to bend even if compared with which the conventional intensifying screen. Therefore, it is suitable when the intensifying screen which is easy to bend in this way is used, and examining an inspected object with small curvature especially.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The intensifying screen for dry type X-ray films characterized by preparing the dispersion prevention layer which consists of lead foil on a base material, and the fluorescent substance layer which distributed the phosphor using rare earth elements in the binder on it.
[Claim 2] The intensifying screen according to claim 1 whose thickness of a fluorescent substance layer it is at least one sort chosen from the group which a base material becomes from a polyethylene terephthalate film with a thickness of 100-200 micrometers, and the binder of a fluorescent substance layer becomes from a nitrocellulose, polyvinyl-butyral and vinyl chloride - vinyl acetate copolymer, and is 70-200 micrometers.

[Translation done.]